PARTIAL LOSS OF THE TIBIA REPLACED BY TRANSFER OF THE FIBULA, WITH MAINTENANCE OF BOTH MALLEOLI OF THE ANKLE.*

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W. B., a boy five years old, had in June, 1904, an acute dissecting periostitis beginning at the lower end of the right tibia and in six days stripping the bone nearly as far as the patellar tubercle. Owing to sloughing of the periosteum after the removal of the shaft the tibia regenerated very imperfectly. Nine months after the onset of the trouble the bone had reformed for about an inch and a quarter from the upper end. There was then a gap of about an inch, below which was a thin strip of bone two inches long, reaching down to within about half an inch of the lower epiphysis from which a little new bone had grown upward. The fibula was normal. The appearance is shown well in the radiograph taken at that time (Fig. 1).

In August, 1905, thirteen months after the onset of the trouble, the boy was admitted to the General Surgical Service of the Children's Hospital for operation. Since ten weeks after the trouble began he had been going about with a plaster bandage and Thomas knee splint.

The attachment of the upper end of the fibula had become loose so that the head of the bone could be shoved upward slightly and the foot could be moved inward for about two and a half inches. There was marked shortening of the leg, varying with the position in which the foot was held. The foot was a little smaller than on the sound side. The fibula had become somewhat hypertrophied, particularly at the middle of the shaft. All wounds were solidly healed (Fig. 2).

It was decided to transfer the fibula into the gap in the tibia.

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The upper end was transferred first. A vertical incision about three inches long was made directly over the lower end of the upper sound portion of the tibia. The cut was made directly through the periosteum which was separated on the fibular side for a vertical distance of about two inches. The muscles were then separated along the interosseous membrane until the fibula at the same level was exposed. In order to reach the fibula more readily a second incision about an inch and a half long was made directly down onto the bone on the outside of the leg. At a point about two inches from the upper end the fibula was then cut across with a chain saw. The upper end of the lower fragment was then inserted into a mortise cut in the tibia. This mortise was cut at a level slightly lower than that at which the fibula was cut across in order to gain length if possible. The periosteum was reflected from that side of the fibula which rested in the mortise. The reflected periosteum of tibia and fibula were then sutured together with chromic catgut to maintain close apposition, and the reflected periosteum of the tibia was further sutured as a cuff around the upper end of the fibula to hold it more securely in position. The muscles were then allowed to slip back into their former positions as far as possible. A few dead spaces were closed by catgut sutures uniting the fasciæ. The incisions were closed without drainage. A sterile dressing and plaster bandage were applied.

An X-ray taken through the plaster three weeks after operation showed that the position of the bone had not changed. After four and a half weeks the boy went to the Convalescent Home. Eleven weeks after operation the plaster was removed. Moderately firm union had occurred. The X-ray showed the upper end of the fibula had been driven upward slightly into the medullary portion of the tibia. A new plaster was applied.

The boy was readmitted to the hospital in January, 1906. At that time the union between the upper end of the tibia and the fibula had become absolutely solid and the shaft of the fibula had materially increased in thickness (Fig. 3).

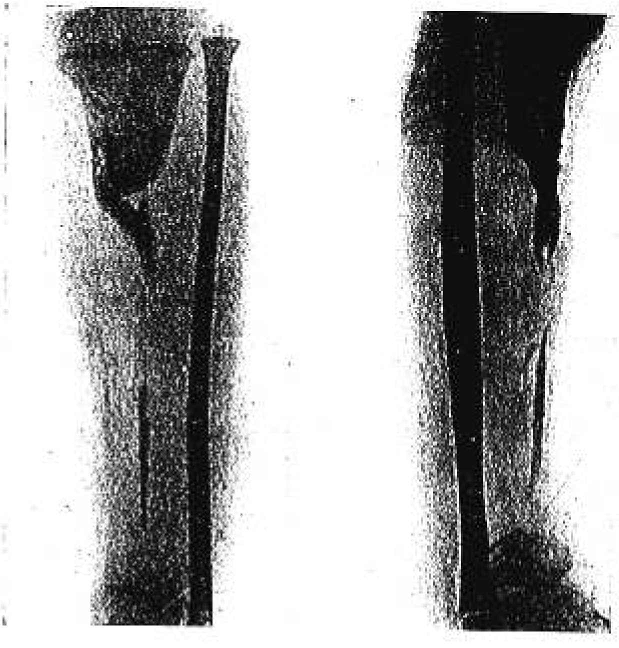
Five and a half months after the first operation a longitudinal incision was made anteriorly over the outer part of the lower end of the tibia. The bone was exposed. By careful dissection the lower end of the fibula was then exposed through the same incision and with a chisel it was split horizontally for a distance of nearly four inches. Great care was taken to avoid separating the periosteum from either half of the bone. At the lower end of the split made in the bone the inner half was cut across transversely at the level of the upper part of the remaining lower epiphysis of the tibia. A small pocket was then cut in the cartilage covering the end of the tibial epiphysis just large enough to receive the inner half of the fibula. The inner half of the fibula was then sprung into its new position in the tibia. In doing so the outer half was broken at its upper end but was still held in place by the periosteum. The inner half remained intact and was retained in its new position by the tension of the muscles. The fascia forming the muscular sheath was sewed with catgut and the skin was closed without drainage. A sterile dressing and plaster of Paris bandage from the toes to the thigh completed the dressing. Three weeks after operation the child was sent home with the plaster bandage not disturbed. An X-ray showed that the bones remained in place.

After three months the plaster was removed. A small granulating spot was found at the lower end of the incision. Bony union was solid. Five days later a small spicule of necrotic bone about three-quarters of an inch long was discharged. After this the skin healed solidly. A month later the boy began to walk on his leg, and ever since has used it without restraint (Fig. 4).

NOTE.—For the series of radiographs which show the conditions better than words can express them I am indebted to Dr. A. W. George, the radiologist of the Hospital.

The problem presented in this case was the restoration to usefulness of a leg in which the fibula was sound, the upper end of the tibia was sound, and in which the lower epiphysis of the tibia remained, but without any shaft above it for a distance of 12 cm., nearly five inches. As might be expected a talipes varus was developing because of the lack of support for the inner side of the foot. The utilization of the fibula to take the place of the tibia seemed the obvious means of relief. The hypertrophy of the fibula, shown in the second set of radiographs, which came on when no weight was being borne upon the leg and when the boy was walking about with a Thomas knee splint, confirmed the hope that the hyper-

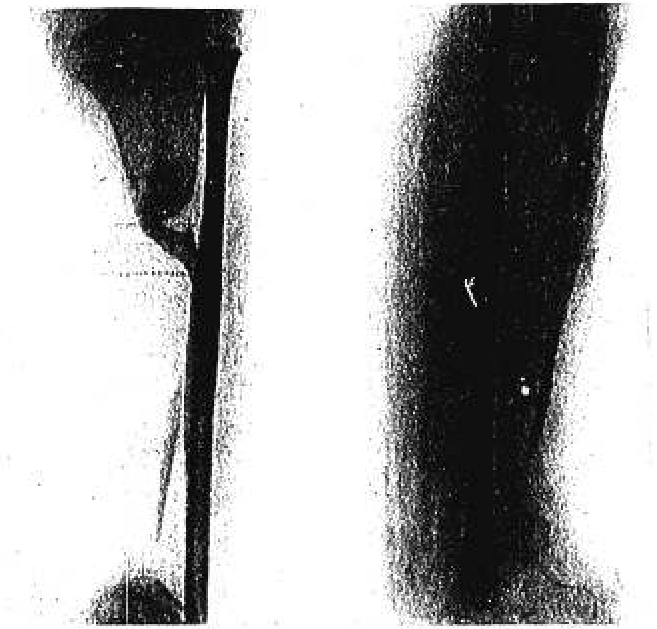
Fig. 1.



Antero-posterior view. Lateral view.

Radiographs taken nine months after the removal of the shaft of the tibia. The amount of regeneration is well shown.

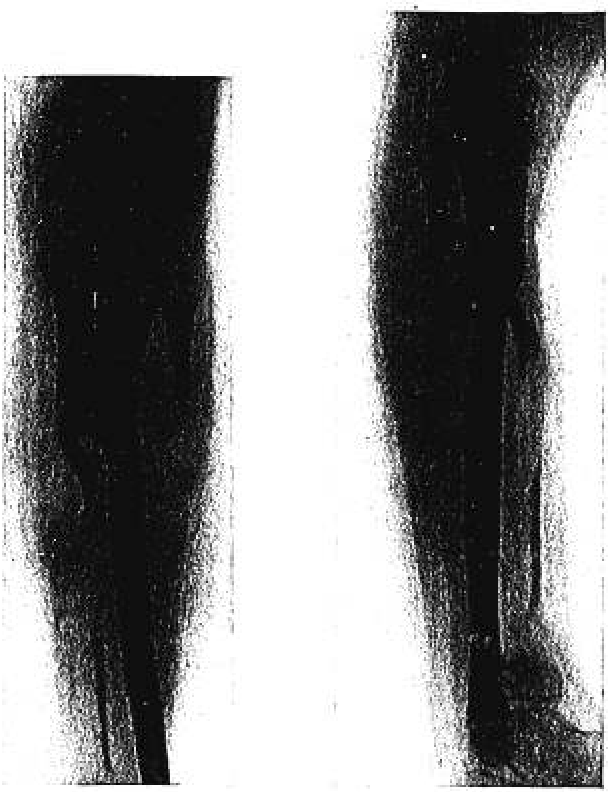
FIG. 2.



Antero-posterior view. Lateral view.

Radiographs taken a year after the removal of the shaft of the tibia. They show that no further regeneration of bone had occurred since the preceding X-rays were taken. They show, however, the beginning hypertrophy of the shaft of the fibula, most pronounced about the middle.

FIG. 3.



Antero-posterior view. Lateral view.

Radiographs taken five months after the first operation. Solid union but slight impaction of fibula into medullary cavity of tibia.

trophy would continue if the functional use of the bone were increased.

The operative procedures especially in the first step were easy. The field of operation was made bloodless by a tourniquet which, however, was removed before the wounds were closed. The utmost care was taken to avoid injury to any nerves or vessels. In cutting across the upper end of the fibula great care was taken to avoid injury to the periosteum. In cutting out the mortise in the upper part of the tibia advantage was taken of an existing hollow in the bone, but the utmost pains were taken in separating the periosteum to avoid tearing it. A side of the fibula bared of periosteum was placed in a freshly cut mortise in the tibia. Bare bone was thus placed next bare bone, while periosteum was sutured to periosteum. A mistake was made in cutting the hole in the tibia a little too deep. The fear was that the fibula might not remain in its position. The fact was that the muscular pull crowded the bone upward into the medullary cavity. If the experience in this case is of value it would seem wise to cut the mortise only so deep that the cortical layer of the entering bone cannot sink inside the cortical layer of the receiving bone.

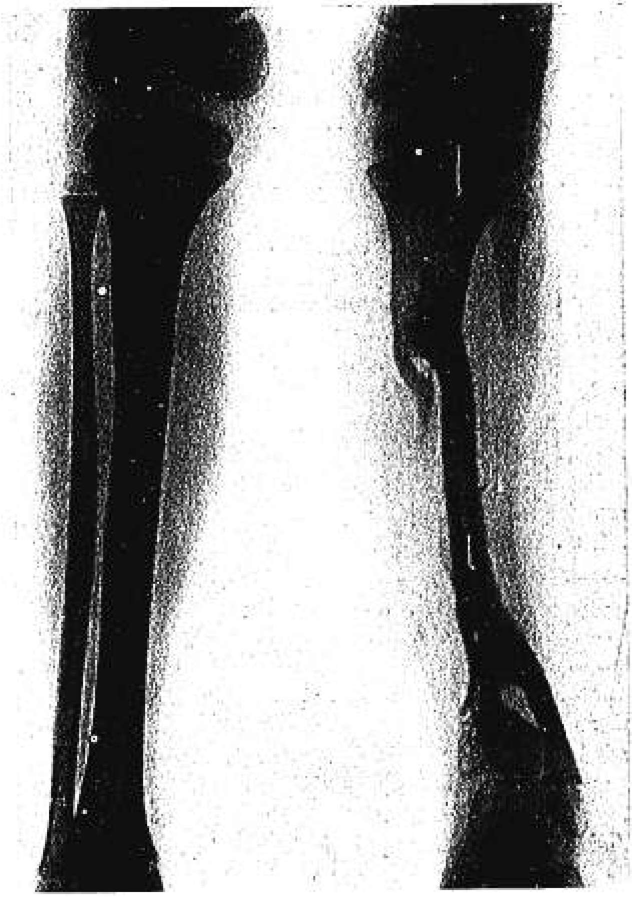
The second step was more difficult than the first. It was necessary to maintain connection between the shaft of the fibula and the external malleolus. If this was lost the outer side of the ankle joint would have been seriously weakened. At the same time it was necessary to bring a portion of the fibula above the lower epiphysis of the tibia. The greatest care was used in splitting the fibula. The periosteum was first cut with a sharp knife. Then in part with a small chisel, in part with a stout knife the bone was divided. Each half of the bone had a thickness of only 4 mm., scarcely over an eighth of an inch, yet in separating them for a distance of about three inches, 8 cm., it was essential that the periosteum remain adherent to each portion and that an equal thickness of each part be maintained throughout. It was planned to spread the halves without breaking either. This proved impossible. Fortunately the outer rather than the inner half gave way close to the upper end of the split between them. In another case it would seen wise to insure a break in the outer half at this point rather than run the risk of breaking the inner half or the outer half at a lower level. The promptness and the extent of the new bone formation from each of the halves were surprising. The trifling amount of necrosis was gratifying.

The continued increase in the size of the transferred bone is most striking, and corresponded in amount with the freedom of use which was allowed. The last radiograph (Fig. 5) was taken after the boy had been using the leg for nine months without any restraint whatever and without any discomfort or disability at all.

In any similar case more prompt transfer of the bone would seem advisable. Nothing was gained by the delay. The length of time allowed between the steps of the operation might also have been shortened.

The result is one of perfect functional usefulness. There is a shortening of 4.2 cm. measured in the radiograph (1⅝ inches) which corresponds with the ordinary clinical measurements. The lower ends of the tibia and fibula are growing symmetrically. While it is not possible to say absolutely how great an interference with growth there may be in the future the present indications are that it will be very slight and will not interfere at all with normal functional use.

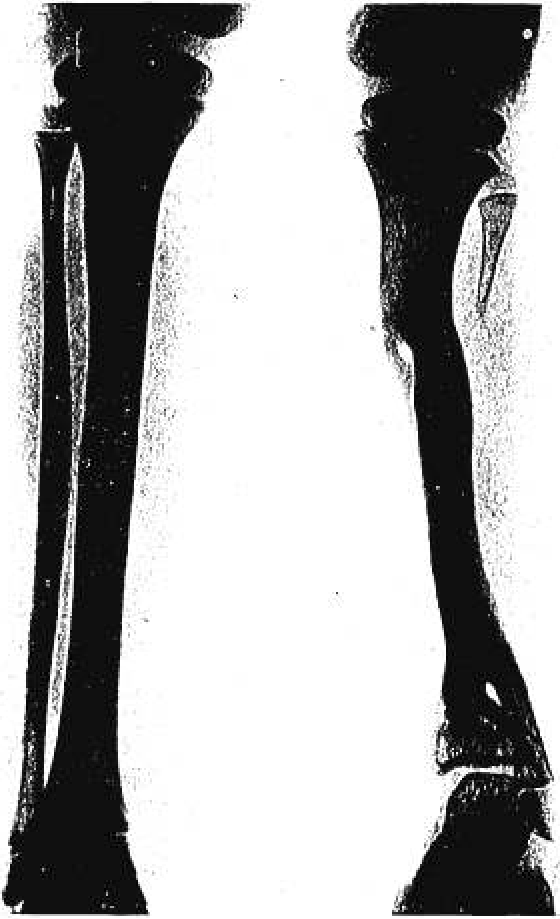
FIG. 4.



Radiograph taken of both legs nearly two years after the removal of the shaft of the tibia, about four months after the fibula was split and the inner half was inserted in the tibia. There is a shortening of exactly 4. cm. (one and a half inches). About one half of this is due to retarded growth, while the other half is due to a crowding up of fibula into the medullary cavity of the tibia.

Note the hypertrophy of the transferred portion of the fibula and compare it with the atrophy of the upper useless end of the fibula. Note the thickening and firm union of the lower divided halves of the fibula. The normal relations of the malleoli and lower end of the tibia are retained. The spot from which the small sequestrum was discharged is shown at the inner side of the bone just above the lower epiphysis of the tibia.

FIG. 5.



Radiograph taken in February 1907, two years and eight months after the removal of the tibia,—nine months after the preceding radiograph. The tremendous increase in the diameter of the transferred fibula occurring under the stimulus of functional use is strikingly shown. Accurate measurements of the radiographs show that the tibia of the normal side has grown 1.1 cm. in length in nine months while the bone on the other side has grown .8 cm. in the same period. In other words, the interference with growth at the lower epiphyseal line of the tibia has been only .3 cm. in nine months. There has been no change in the relations between the lower epiphyseal lines of the tibia and fibula. There is no tendency toward the development of a talipes varus or talipes valgus.